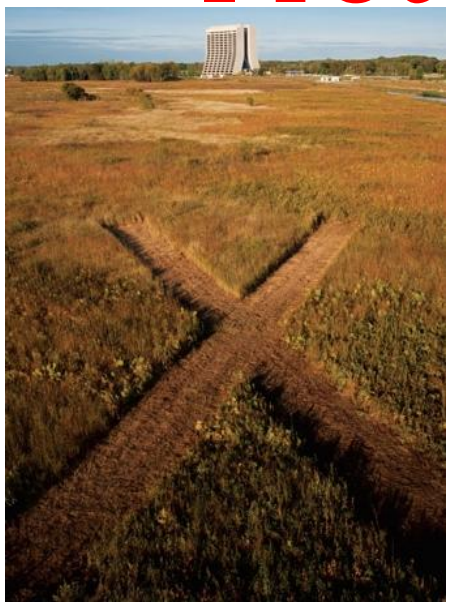
Proton Beam for PRISM



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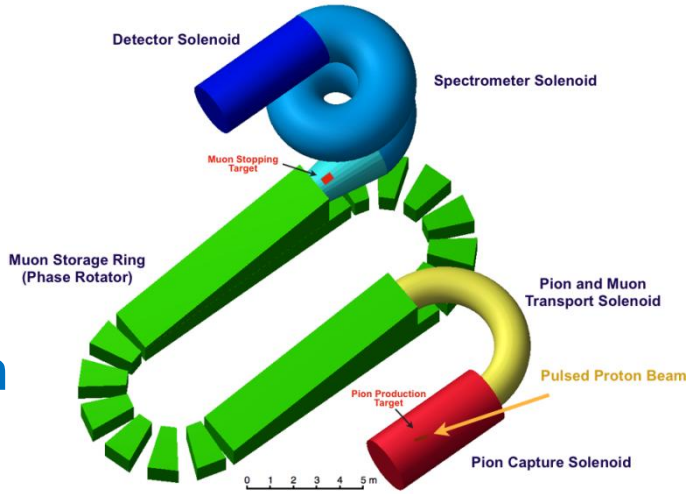


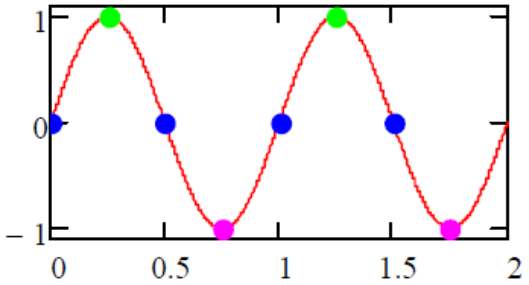
5th Workshop Project X Physics – Muons
November 8, 2010

Outline

- Review of Project X beam
- PRISM beam requirements
- Changing bunch structure
- Issues

Project X Beam Review

- 3GeV beam energy out of CW Linac
- 325MHz bunches (3.1ns spacing)
  - RF splitter doubles spacing
  - 50ps bunch width



- 1.9×10^8 particles/bunch (10mA for < 1μsec)
- Linac average beam current 1mA (>1 μsec)
  - 3MW out of Linac possible
- H^- beam out of Linac
  - Preference to convert beam to protons before 3 way RF splitter

PRISM Beam Requirements

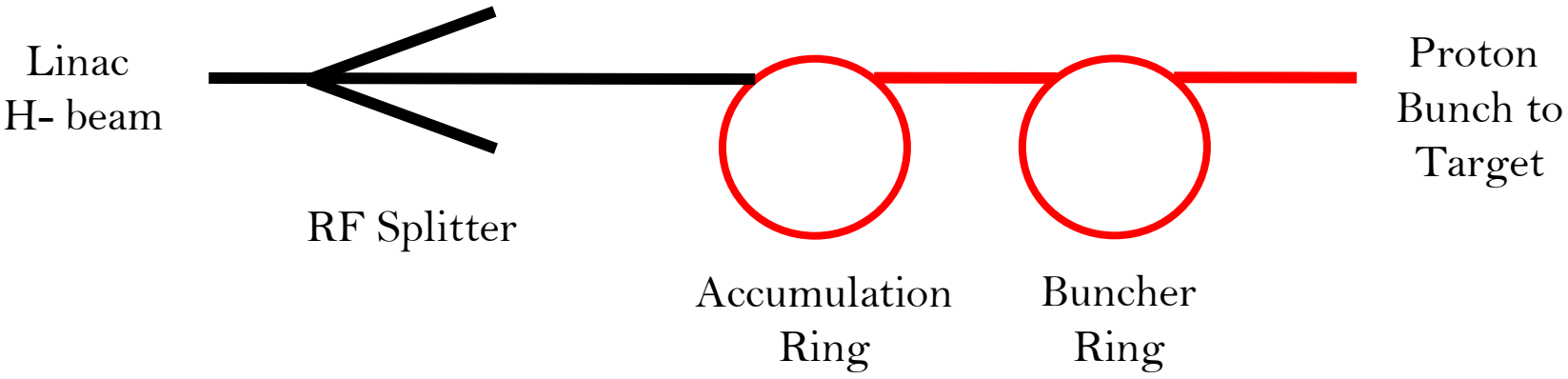
- 1MW of proton beam power
  - Already asking for more beam power
    - More beam current (towards 4MW)
    - Increase CW Linac energy
- Repetition rate of ~1kHz
  - Believed to be limit of injection/extraction kickers of muon storage ring
    - 2×10^{12} protons every 1ms
- Bunch width of 10ns
  - A narrower width is desirable

Changing Bunch Structure (1)

- Need to accumulate beam
  - Change 162.5MHz beam out of RF splitter to 1kHz beam onto target
  - Requires H^- beam out of RF splitter
  - Accumulation Ring will have stripping system and dump
    - To accept unconverted beam (H^- and H^o)
  - Requires programmable Linac front end to populate appropriate Linac bunches such that the appropriate Accumulation Ring RF bunch(s) are filled
    - Leave kicker gap using barrier RF system
    - Set initial bunch length before RF manipulations

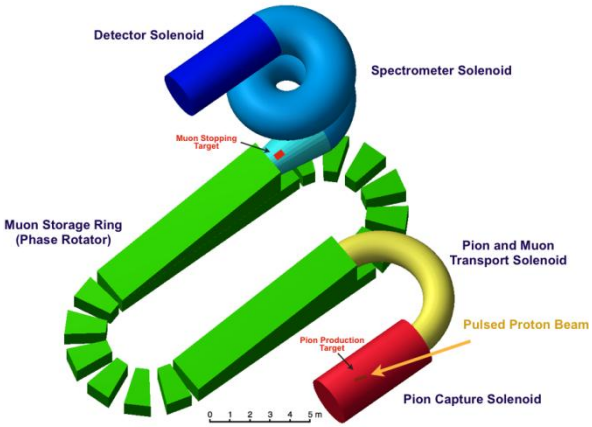
Change Bunch Structure (2)

- Final bunch length requires RF manipulation
  - After accumulation, beam transferred to second ring: Buncher
  - Buncher will perform final RF bunch rotation to achieve short bunch length



Issues (1)

- Injection/Extraction Kickers
  - 1kHz kickers are the same technological issue as for PRISM Muon Storage Ring
    - Repetition rate
    - Rise time or fall time



- Beam Dynamics
  - Space Charge?
  - Beam size in dipoles at final bunch length
- RF
  - How much required to perform manipulations at required rate?

Issues (2)

- H^- beam out of RF splitter
  - Requires lower field in downstream Lambertson to avoid Lorentz stripping of H^- beam
    - Affects layout of switchyard area
    - Each area will need own stripping system
- Stripping system and beam dump
  - Quantum mechanics of stripping systems
    - >95% easy but leaves tens of kW beam power

Summary

- Project X can provide the amount of proton beam necessary for PRISM
- Work will be needed to convert bunch structure